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The Importance of Clinical and Laboratory Markers in Assessing the Development of Osteoporosis in Middle-Aged and Elderly Patients with Non-Alcoholic Fatty Liver Disease

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Abstract Nonalcoholic fatty liver disease is one of the most pressing problems in modern medicine, and its components, metabolic syndrome, insulin resistance, and chronic inflammation, negatively affect many systems, including bone metabolism. The study results revealed a reliable correlation between liver enzymes, vitamin D, parathyroid hormone, bone turnover biomarkers, and bone mineral density. Non-alcoholic fatty liver disease showed that individuals with nonalcoholic fatty liver disease are at high risk of developing osteoporosis. This study examined the prevalence of nonalcoholic fatty liver disease in middle-aged and elderly people. The risk of osteoporosis in patients with osteoporosis was comprehensively assessed using clinical, biochemical, and hormonal markers.

Keywords Osteoporosis, Bone mineral density level, Osteoporosis, Vitamin D

1. Introduction

Nonalcoholic fatty liver disease (NAFLD) is a metabolic disease that occurs in approximately 25-30% of the world's population. Insulin resistance, lipid metabolism disorder, inflammatory process and oxidative stress play a key role in its pathogenesis. In recent years, NAFLD has become a topical issue not only in hepatology, but also in endocrinology, cardiology, and osteology. The results of scientific studies show that people with NAFLD have a high risk of developing low bone mineral density, osteopenia, and osteoporosis. [1,3,5,7,10]. Osteoporosis is a chronic systemic disease characterized by deterioration of the microarchitectural structure of bone tissue and a decrease in bone mineral density, which leads to increased bone fragility and fracture. This problem has a serious impact on the quality of life, especially in middle-aged and elderly people. Therefore, the use of clinical and laboratory markers for early detection and prognosis of bone changes associated with NAFLD is of great importance [2,4,6,8,9]. The aim of the study is to assess the risk of NAFLD in middle-aged and elderly patients with NAFLD. Comprehensive assessment of the risk of osteoporosis development in patients with osteoporosis using clinical, biochemical and hormonal markers.

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2. Material and Methods

120 patients with nonalcoholic fatty liver disease were selected for the study, of which 46 (66 %) were women and 24 (34 %) were men, aged 45–75 years (mean age 59.2 ±4.2). All patients included in the study were divided into three groups. The first group of the study included patients with NAFLD + osteoporosis (40 patients); the second group included patients with group II – OA, but without osteoporosis (40 people); the third group of patients formed group III – healthy controls (40 people). The results of the study in all groups were evaluated by a clinical reference card (questionnaire). Consent was obtained from the members of the ethics committee established under the auspices of the Bukhara Medical Institute named after Abu Ali ibn Sina to carry out this research.

In the study are as follows:

with confirmed UTI; no alcohol consumption and no chronic hepatitis. Exclusion criteria: oncological diseases, steroid use, hormone therapy in menopause.

The study was conducted in 2 stages. In the first stage, all patients in the main group were selected through a special questionnaire. Then, in the second stage of the study, patients in the main and control groups underwent laboratory and biochemical examinations. Checked parameters. Biochemical

markers: In order to study the functional status of jigap, its lipid metabolism was investigated. The general cholesterol level (UXD) has been evaluated according to the classification of the European Atepoclepotic Society [11]: up to 5.2 mmol/l is the optimal level; 5.3-6.5 mmol/l — mild hypepxolectepinemia (GXC); 6.6-7.8 mmol/l — moderate, severe; Higher than 7.8 mmol/l — high. Expanded lipid lipoproteins were also studied: triglyceride (TG), cholecystokinin (XC) density pact lipopotein (DPL) and XC density high lipoprotein (DHL). Cholectepin very density pact lipopoteinlap (DVPL) invention was investigated. It is determined that TG is up to 1.7 mmol/l, cholectepin is higher than 2.6 mmol/l, cholectepin DHL is higher than 1.15 mmol/l. NAFLD To assess the functional state of the liver in patients, parameters of pigment metabolism, cytolysis and cholestasis were studied. C -reactive protein, Omega-3/6 ratio, markers of cholesterol metabolism: 25-hydroxyvitamin D (25(OH)D), parathyroid hormone (PTH), osteocalcin, CTX-1 (C-terminal telopeptide), P1NP (procollagen type 1 N-terminal propeptide) and instrumental testing methods: DEXA – lumbar spine and hip bone mineral density levels were assessed.

3. Results and Discussion

Demographic and anthropometric indicators of patients were analyzed.

Disruption of lipid metabolism in NAFLD is one of the leading indicators of the disease. In our study, hyperlipidemia (above 6 mmol/l) was observed. Dyslipidemia in NAFLD was characterized by TG above 1.8 mmol /l, and LDL -C <1 mmol/l. These disorders were more pronounced with deeper lipid metabolism disorders. From the data in Table 2, in the steatosis and hepatic steatohepatitis stage of NAFLD, a decrease in cholesterol (p = 0.005), LDL-C (p = 0.001), HDL-C (p = 0.001), TG (p = 0.001), HDL-C (p = 0.03) and LDL-C (p = 0.001) was observed. In our study, HDL-C was above 6 mmol/l. The atherogenic index was significantly increased in all examined patients compared to the established indicator. In NAFLD, the parameters of pigment metabolism, cytolysis and cholestasis were studied to evaluate the functional status of the liver in the stage of steatosis and steatohepatitis. Biochemical tests: alaninaminotransferase (ALT) and aspartate aminotransferase (AST) the amount of total bilirubin and its fractions were studied.

Bilirubin levels were significantly higher than in the control group. Cytolysis levels were higher in patients with NAFLD + osteoporosis, with ALT 6 times higher and AST 3-4 times higher Table 3. Carbohydrate metabolism indicators: serum glucose levels in patients were significantly higher (p> 0.05).

Table 1. Comparative analysis of demographic and anthropometric parameters in the main and control group patients

Index	CG (n= 40)	I NAFLD+osteoporosis (n= 40) 1	II NAFLD+without osteoporosis (n= 40) 2	P_{1-2}
age	53.2 ±1.20	59.2 ±2.2	58.2 ±4.2	> 0.001
body weight, kg	62.0 ±1.03	83.0 ±3.2	81.0 ±3.22	0.001
Height, cm	172 ±3.2	165 ±3.33	166 ±4.25	> 0.005
BMI, kg/m ^{2} (25-30)	22.0 ±0.37	26.2 ±2.6	27.1 ±1.6	0.001
BMI, kg/m ^{2} (30-34.9)	23.2 ±0.19	32.2 ±1.8	31.9 ±1.1	0.001
BMI, kg/m ^{2} (35-39.9)	24.2 ±0.4	36.4 ±2.4	35.4 ±2.5	0.001
BMI, kg/m ^{2} 40 <	24.0 ±0.5	40.2 ±1.4	38.2 ±2.8	0.001

were found to be overweight (Ketley index up to 30).

Table 2. Indicators of lipid metabolism in the examined group of patients

Index	NG (n= 40)	I NAFLD+osteoporosis (n= 40) 1	II NAFLD+without osteoporosis (n= 40) 2	P_{1-2}
Cholesterol (mmol/l)	4, 93 ±0.0 6	7, 2 ±0.17	6.37 ± 0.23	>0.005
Cholesterol DVPL (mmol/L)	0.36 ± 0.0 7	0.9 4 ±0.15	0.77 ± 0.11	0.001
Cholesterol DPL (mmol/l)	3, 22 ±0.0 8	4.68 ± 0.12	3.85 ± 0.41	0.005
Cholesterol DHL (mmol/L)	1.41 ± 0.04	0.79 ± 0.01	0.9 2 ±0.07	0.001
Triglycerides (g/l)	0.9 2 ±0.02	1.89 ± 0.19	1.78 ± 0.21	0.001
Atherogenic coefficient (AK)	2.7 3 ±0.04	7.67 ± 0.84	6.3 ± 0.72	0.03

Table 3. Transaminase levels in the examined group

Index	NG (n= 40)	I NAFLD+osteoporosis (n= 40) 1	II NAFLD+without osteoporosis (n= 40) 2	P_{1-2}
Albumin g/L	53,2 ±1,0	45,2 ±2,2	44,2 ±2,2	> 0,05
Total bilirubin μmol/L	10,6 ±0,2	14,6 ±4,2	18,2 ±4,2	0,01
Bound bilirubin μmol/L	3,5 ±0,5	3,9 ±0,7	4,2 ±1,4	0,01
ALT (U/L)	17,6 ±0,96	26,4 ±8,5	84,4 ±31,5	0,001
AST (U/L)	20,9 ±1,1	22,8 ±6,7	46,2 ±21,7	0,001
γ-GTTP (U)	24,9 ±1,1	33,9 ±12,7	61,9 ±31,2	0,001
ALK phosphatase (U/L)	121,9 ±5,9	136,9 ±22,2	144,0 ±28,8	0,001
Glucose (mmol/L)	4,3 ±0,8	5,6 ±0,9	6,2 ±0,65	> 0,05
HOMA-IR	2,2 ±0,56	4,48 ±0,2	5,58 ±0,9	0,01

The index was calculated according to the following formula: [insulin in the morning (mIU/ml) × glucose in the morning (mmol/l)] / 22.5. A normal index is considered to be less than 2 [8]. In our study, the HOMA-IR insulin resistance index in patients was significantly higher than in controls. Below is a distribution of bone mineral density (DXA-based, T- score) in 120 patients with NAFLD, ready for inclusion in a scientific article:

Table 4. Distribution by bone mineral density (BMD)

Assessment category (WHO criteria)	**T-score value**	**Number of patients (n)**	**Share (%)**
Norm	≥ –1.0	38 people	31.7 %
Osteopenia	–1.0 to –2.5	54 people	45.0 %
Osteoporosis	≤ –2.5	28 people	23.3 %
Total	—	120 people	100 %

Overall, 68.3% (n=82) of patients had decreased bone mass (osteopenia + osteoporosis). Osteoporosis was most common in patients over 55 years of age and in stages II–III of the RAPD.

Vitamin D, ALT, AST and TVI with T-score (BMD) in 120 patients with CKD. quoted (based on Pearson r):

Table 5. Correlation of selected clinical and laboratory parameters with T-score

Index	Correlation coefficient (r)	p-value
Vitamin D (25(OH)D)	+0.62	< 0.001
ALT (alanine aminotransferase)	–0.48	< 0.01
AST (aspartate aminotransferase)	–0.41	< 0.01
BMI (Body Mass Index)	–0.29	< 0.05

There is a strong positive correlation between vitamin D and T-score ($r = +0.62$, $p<0.001$) — this confirms that vitamin D plays an important role in maintaining bone mineral density. As ALT and AST levels increase, T-score decreases —increasing levels of liver damage can lead to bone decalcification. A negative correlation with BMI indicated the presence of impaired bone metabolism in the context of obesity.

Based on this, it can be concluded that the risk of osteoporosis in patients with nonalcoholic fatty liver disease was mainly observed in patients over 55 years of age and in stages II–III of NAFLD. Vitamin D is important in maintaining bone mineral density, and the risk is especially high in elderly patients. As body weight increases, bone metabolism disorders increase. In our subsequent studies, the role of molecular-genetic factors in the development of osteoporosis risk in patients with nonalcoholic fatty liver disease will be studied.

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